16

MAGNETIC SUSCEPTIBILITY OF GRAPHITE ALONG DIRECTIONS IN THE BASAL PLANE

Miss D. DAS

Department of Magnetism

Indian Association for the Cultivation of Science,

Calcutta-32, India.

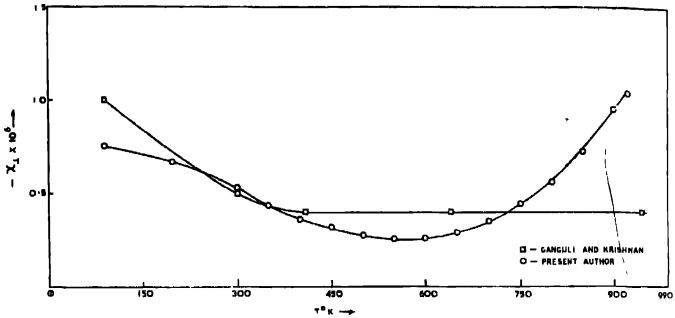
(*Received July* 21, 1966)

The four electron Brillouin zone in graphite (Dutta 1959; McClure 1957) with a small overlap over only the vertical zone boundary so that the motion of the free carriers are mostly confined in the hexagonal plane, but with a thermal overlap evidently confined in directions perpendicular to the plane, is capable of explaining to a large extent the abnormal anisotropic diamagnetism, the electrical conductivity of the graphite crystals as also the fact observed by Dutta (1953) Ubbelohde and others (1957) that along the c-axis electrical conductivity increases with temperature, arising from the effect of the thermal excitation

It is then to be expected that the thermally excited electrons responsible for this property, should also contribute towards the magnetic susceptibilities in the basal plane. Krishnan and Ganguli (1939, 1941) gave little importance to the accurate measurement of the small values of $\chi_\perp$, the susceptibility perpendicular to the c-axis, and its temperature dependence compared to that of the large value of $\chi_\parallel$, the susceptibility along directions parallel to the c-axis We have therefore carried out a series of very accurate and sensitive measurements of $\chi_\perp$ over a wide range of temperature and the results are graphically represented in fig. 1, wherefrom it is evident that with the rise of temperature $\chi_\perp$ first slowly decreases upto about 550°K remains steady and then finally begins to increase from about 600°K with further rise of temperature. Krishnan and Ganguli's (1939) results are also given in the same graph for comparison.

This increase of $\chi_\perp$ with rise of temperature at higher temperatures observed by us is evidently to be attributed to the increase in the number of carriers, as in case of many other semiconductors, grey tin for example (Busch and Mooser 1953), by the process of thermal excitation across the Brillouin zone boundaries perpendicular to the c-axis. This excitation may be either intrinsic or extrinsic or combination of these. Ubbelohde's (1960) observation, of a probably positive sign of thermoelectric power along the c-axis in graphite, seems to indicate more in favour of the extrinsic process, the carriers being positive holes. But before ac-

cepting such a view more accurate investigations on Hall-effect and thermoelectric effect are necessary.



Temperature variation of $X_\perp$, the susceptibility of Graphite along the basal plane. $X_\perp$ in C.G.S. e.m.u

The observed decrease of $\chi_\perp$ with the rise of temperature at low temperatures is to be ascribed according to the suggestion of Bhattacharya (1965), to the presence of a component of $\chi_{\parallel}$ (the abnormal part of susceptibility in graphite) due to crystalline derangements, the decrement getting progressively smaller with the rise of temperature. A quantitative estimate of the observed values of $\chi_\perp$ according to the above suggestions is in progress and will be published soon

In conclusion the author wishes to express her best thanks to Shri A. K Dutta for suggesting the problem and guidance throughout the course of the work.

REFERENCES

Bhattacharya, R , 1965, *Indian J. Phys.* **39**, 53, 300.
Busch, G and Moosor, E., 1953, *Helv. Phys. Acta*, **26**, 611.
Dutta, A. K., 1953, *Phys. Rev.* **90**, 187.
————, 1959, *Proc. Phys. Soc.* **74**, 604.
Krishnan, K. S. and Ganguli, N. 1939, *Z. Kristallogra.* ***A*100**, 530.
——— --, 1941, *Proc. Roy. Soc.* ***A*177**, 168.
McClure, J. W., 1957, *Phys. Rev.* **108**, 612.
Ubbelohde, A. R., Blackman, L. C. F. and Dundas, P. H , 1960, *Proc. Roy. Soc.* **255**, 293.
Ubbelohole, A. R. and Orr, J. 1957, *Nature, Lond.* **179**, 193.